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SUBMARINE DEBRIS FLOWS AND THEIR DEVOLUTION INTO TURBIDITY CURRENTS ON THE CONTINENTAL SHELF

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LONG-TERM GOAL

The long-term goal of the project is to incorporate the mechanics of submarine debris flows and associated turbidity currents on the continental slope into a predictive model of the evolution of continental slope morphology and stratigraphy.

SCIENTIFIC OBJECTIVES

The objectives of the project are as follows. 1. Characterize the dynamics of flow and deposition of submarine debris flows. 2. Characterize their devolution into turbidity currents, and the dynamics of flow and deposition of those turbidity currents. 3. Incorporate the understanding of event dynamics into a model of continental slope evolution.

APPROACH

The research is being pursued through experimental and numerical means. Experiments are being conducted in the "Fish Tank," a large facility developed for the study of submarine debris flows and turbidity currents. The research is being tied into field observations through cooperation with other researcher in STRATAFORM and field research conducted by the broader research community.

WORK COMPLETED

Five pieces of research were completed in fiscal year 1997 (October 1, 1996 to September 31, 1997). 1) An experimental study of the ability of submarine and subaerial debris flows to remobilize antecedent deposits has been completed. The research has been presented a paper at the San Francisco meeting of the American Geophysical Union in December, 1996, and has also been submitted and accepted for publication in Marine Geology (Mohrig, Elverhoi and Parker, 1997). 2) An experimental study of the erosion of the head of debris flows into turbidity currents has produced preliminary results, which will be presented at the San Francisco meeting of the American Geophysical Union in December, 1997. 3) An experimental study of debris flows with low clay content has been completed. The results will be presented at the San Francisco meeting of the American Geophysical Union in December, 1997. In addition, a draft version of a manuscript has been prepared for submission to the Journal of Sedimentary Research (Marr, Harff, Shanmugam and Parker, 1997). 4) A numerical model of debris flows, BING, has been written and documented. The software has been supplied to other members of STRATAFORM. 5) A new concept of continental margin modeling, "whole-margin modeling" has been developed so as to allow for later embedding of the debris flow and turbidity current models.

RESULTS

The studies of remobilization suggest that reactivation of antecedent debris deposits in the submarine environment by an overpassing debris flow is strongly suppressed in the submarine environment. The studies of suspension into a turbidity current allow for a first look at the rate of entrainment and size distribution of

material entrained. The work on sandy debris flows indicates that relatively small amounts of clay can allow for active, mobile debris flows. If no fines at all are present, however, debris flows composed purely of sand cannot occur. The numerical model of submarine debris flows has been provided to several other research groups in STRATAFORM, and has already been incorporated into the modeling of the INSTAAR group (University of Colorado Boulder). The whole-margin concept of modeling has been developed to the point of allowing for interacting components consisting of a) a fluvial plain, b) a shelf, c) a slope and d) a rise, with freely moving boundaries between all segments.

IMPACT/APPLICATION

The research has had an impact within the STRATAFORM, in particular by providing a baseline for interpreting the importance of submarine debris flows as a margin process. Part of the work has already been incorporated in the modeling of the INSTAAR group (University of Colorado). A cooperative research program with the Univesity of Oslo, Norway helped spur the research on remobilization of antecedent debris flow deposits. Finally, the research has attracted considerable interest from the oil industry, with supplementary funding received from Mobil Oil and interest expressed by several other companies.

TRANSITIONS

The next important transition is the completion of the process of embedding the mechanics of submarine debris flows and associated turbidity currents into a model of slope evolution.

RELATED PROJECTS

Research on incipient channelization on submarine fans has proceeded under the auspices of an NSF grant. Funding has recently been approved for a study of meandering channels produced by turbidity currents.

The research on sandy debris flows has received supplementary funding from Mobil Oil.

An NSF/ARI project for the construction of a facility for the study of large-scale river morphology, drainage basin evolution and basin stratigraphy has been proceeding for two years. A prototype of the facility has been built, and is being used to study margin dynamics.

REFERENCES

Mohrig, D., Whipple, K. X., Hondzo, M., Ellis, C. and Parker, G. Hydroplaning of subaqueous debris flows. In press, *Bulletin of the Geological Society of America*, 1997.

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